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(54) **Titre :** FIBRE THERMOUSOUDABLE POUR TEXTILES NON TISSES DE GRANDE RESISTANCE

(54) **Title:** THERMALLY BONDABLE FIBER FOR HIGH STRENGTH NON-WOVEN FABRICS

(57) **Abrégé/Abstract:**

Thermobondable fiber of at least one first component of polypropylene having a melt flow rate of 0.5-30, and at least one second component of polypropylene having a melt flow rate of 60-1000.



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ABSTRACT OF THE DISCLOSURE

Thermobondable fiber of at least one first component of polypropylene having a melt flow rate of 0.5-30, and at least one second component of polypropylene having a melt flow rate of 60-1000.

**THERMALLY BONDABLE FIBER FOR HIGH STRENGTH
NON-WOVEN FABRICS**

This invention relates to polypropylene fibers suitable for use in the manufacture of non-woven fabrics, processes for making them, compositions comprising such fibers, non-woven fabrics containing them, and articles containing these non-woven fabrics.

The production of polypropylene fibers and filaments usually involves the use of a mix of a single polymer with nominal amounts of stabilizers and pigments. The mix is melt extruded into fibers and fibrous products using conventional commercial processes. Non-woven fabrics are typically made by making a web of the fibers, and then thermally bonding the fibers together where they meet. More specifically, staple fibers are converted into non-woven fabrics using, for example, a carding machine, and the carded fabric is thermally bonded. The thermal bonding can be achieved using various heating techniques, including heating with heated rollers and heating through the use of ultrasonic welding.

Conventional thermally bonded non-woven fabrics exhibit good loft and softness properties, but less than optimal cross-directional strength, and less than optimal cross-directional strength in combination with high elongation. The strength of the thermally bonded non-woven fabrics depends upon the orientation of the fibers and the inherent strength of the bond points.

Over the years, improvements have been made in fibers which provide stronger bond strengths. However, further improvements are needed to provide even higher fabric strengths to permit use of these fabrics in today's high speed converting processes for hygiene products, such as diapers and other types of incontinence products. In particular, there is a need for a thermally bondable fiber and a resulting non-woven fabric that possess high cross-directional strength and high elongation. Additionally, there is a need for a one-step process for making staple fiber known as a "short spin" process that provides filaments and fibers with properties as good as those produced by a two-step process called a "long spin" process.

According to the invention, a fiber is provided comprising at least one polypropylene having a melt flow rate of about 0.5-30, and at least one polypropylene having a melt flow rate of about 60-1000.

5 Preferably, based on the weight of the fiber, the fiber comprises at least about 3.0% by weight of the polypropylene having a melt flow rate of about 0.5-30, and at least about 3.0% by weight of the polypropylene having a melt flow rate of about 60-1000. More preferably, the fiber comprises at
10 least about 10.0% by weight of the polypropylene having a melt flow rate of about 0.5-30, and at least about 10.0% by weight of the polypropylene having a melt flow rate of about 60-1000.

Preferably, the fiber comprises at least one polypropylene having a melt flow rate of about 1-25, and at
15 least one polypropylene having a melt flow rate of about 200-1000.

Preferably, based on the weight of the fiber, the polypropylene having a melt flow rate of about 0.5-30 is present in an amount of about 5-95%, and the polypropylene
20 having a melt flow rate of about 60-1000 is present in an amount of about 5-95%. More preferably, the fiber comprises about 2-5 % by weight, preferably about 3% by weight, of polypropylene having a melt flow rate of about 0.5-5, preferably about 0.8-5.0, and more preferably about 1.0-3.0,
25 about 70-85% by weight, preferably about 75% by weight, of polypropylene having a melt flow rate of about 10-20, preferably about 10-15, and about 10-28 % by weight, preferably about 22% by weight, of polypropylene having a melt flow rate of about 300-600, preferably about 350-450.

30 Also according to the invention, the fiber has an average rheological polydispersity index of at least about 4.5, preferably at least about 5.0, more preferably about 5.5, and a preferred range of about 5.0 - 7.0. Further, the fiber has a viscoelastic constant of about 1.5-2.0, a fiber elongation
35 of at least about 250%, a fiber tenacity less than about 2.5 g/denier, and a size less than about 5 dpf. As utilized in this application dpf denotes denier per filament, with denier being defined as weight in grams per 9,000 meter length of filament.

The fiber can contain at least one additive, and the at least one additive can comprise at least one stabilizer.

Also according to the invention, a composition is provided comprising at least one polypropylene having a melt
5 flow rate of about 0.5-30, preferably, about 1-25, and at least one polypropylene having a melt flow rate of about 60-1000, preferably, about 200-1000. This composition can contain similar components and have similar characteristics as the above-described fiber. For example, the composition
10 can have an average rheological polydispersity index of at least about 4.5, preferably of at least about 5.0, more preferably at least about 5.5, and a preferred range of about 5.0-7.0, and can contain at least one additive, such as at least one stabilizer.

Also, the composition can comprise, based on the weight of the composition, at least one polypropylene having a melt
15 flow rate of about 0.5-30 is present in an amount of about 5-95%, and at least one polypropylene having a melt flow rate of about 60-1000 is present in an amount of about 5-95%. Preferably, based on the weight of the composition, the composition comprises at least about 3.0% by weight of the
20 polypropylene having a melt flow rate of about 0.5-30, and at least about 3.0% by weight of the polypropylene having a melt flow rate of about 60-1000. More preferably, the composition comprises at least about 10.0% by weight of the polypropylene
25 having a melt flow rate of about 0.5-30, and at least about 10.0% by weight of the polypropylene having a melt flow rate of about 60-1000.

Preferably, the composition comprises about 2-5% by
30 weight, preferably about 3% by weight of polypropylene having a melt flow rate of about 0.5-5, preferably about 0.8-5, and more preferably about 1.0-3.0, about 70-85% by weight, preferably about 75% by weight, of polypropylene having a melt
flow rate of about 10-20, preferably about 10-15, and about
35 10-28% by weight, preferably about 22% by weight, of polypropylene having a melt flow rate of about 300-600, preferably about 350-450.

The invention also contemplates providing a fiber comprising a mixture of at least two components, the at least

two components comprising at least one first component of polypropylene having a melt flow rate of about 0.5-30, and at least one second component of polypropylene having a melt flow rate of about 60-1000, preferably about 200-1000, and an average melt flow rate of about 5-40, preferably about 10-30, and more preferably about 15-25.

Also according to the invention, a polypropylene containing fiber is provided having an average melt flow rate of about 5-40, preferably 10-30 and more preferably about 15-25, and containing at least about 3.0% of at least one polypropylene having a melt flow rate of about 200-1000, and preferably containing at least about 10% of the at least one polypropylene having a melt flow rate of about 200-1000.

Also according to the invention, a polypropylene containing fiber is provided having an average rheological polydispersity index of at least about 4.5, preferably of at least about 5.0, more preferably of at least about 5.5, and a preferred range of about 5.0 to 7.0, and containing at least about 3.0% of at least one polypropylene having a melt flow rate of about 200-1000, and preferably containing at least about 10% of the at least one polypropylene having a melt flow rate of about 200-1000. Preferably, the polypropylene containing fiber has an average melt flow rate of about 5-40, more preferably about 10-30, and most preferably about 15-25.

Also according to the invention, a thermobondable polypropylene fiber is provided comprising components having a zero shear viscosity of at least about 2.0×10^4 poise, and a viscoelastic constant of at least about 1.5.

Also according to the invention, a thermally bondable fiber is provided having an average rheological polydispersity index of at least about 5.0, preferably of at least about 5.5, and a preferred range of about 5.0-7.0.

All of the fibers according to present invention have a substantially uniform morphology, demonstratable by being substantially uniformly stainable with ruthenium tetroxide.

According to the invention, a process is provided for spinning polypropylene containing filaments comprising melt spinning a polypropylene composition having a broad molecular

weight distribution through at least one spinnerette to form molten polypropylene containing filaments; and quenching the molten polypropylene containing filaments to obtain polypropylene containing filaments having an average
5 rheological polydispersity index of at least about 5.0, preferably of at least about 5.5, and a preferred range of about 5.0-7.0.

The spinning speed can be about 30 to 200 meters per minute, preferably about 80-100 meters per minute, and the
10 polypropylene containing filaments can be continuously drawn and crimped, as practiced with the short spin process. Alternatively, the spinning speed can be about 500 to 2500 meters per minute, preferably about 1100-2000 meters per minute, and the polypropylene containing filaments can be
15 drawn and crimped at a speed of about 50 to 250 meters per minute, preferably about 150-200 meters per minute, in a second step according to the long spin process.

The quenching according to the process according to the invention can be effected to obtain a substantially immediate
20 cooling of the molten polypropylene containing filaments as the molten polypropylene containing filaments exit the at least one spinnerette. Preferably, the quench comprises an air quench having a velocity, for a "short spin" process, of about 10-45 meters/second, preferably about 25-35
25 meters/second, and more preferably about 30 meters/second; and, for a "long spin" process, of about 1.5-4.0 meters/second, preferably about 2.0 meters/second. The quench air temperature is about 10-40°C, preferably about 15-30°C, and more preferably either about 15-20°C or about 37°C.

Also according to the invention, a process is provided
30 for spinning polypropylene containing filaments comprising melt spinning a polypropylene containing composition having a broad molecular weight distribution through at least one spinnerette at a spinning speed of about 30 to 200 meters per
35 minute, preferably about 80-100 meters per minute, to form molten polypropylene containing filaments; and quenching the molten polypropylene containing filaments. Preferably, the quenched filaments have an average rheological polydispersity index of at least about 4.5, more preferably of at least about

5.0, even more preferably of at least about 5.5, and a preferred range of 5.0-7.0. Preferably, the polypropylene containing composition comprises at least one polypropylene having a melt flow rate of about 0.5-30, and at least one polypropylene having a melt flow rate of about 60-1000.

Also, according to the invention, a process is provided for producing a thermobondable fiber having an average rheological polydispersity index of at least about 4.5, preferably at least about 5.0, and more preferably about 5.0-7.0 which is substantially maintained throughout the process, comprising melt spinning at a speed of 30-200 meters/sec., a polypropylene containing composition having a broad molecular weight distribution with an average rheological polydispersity index of at least about 4.5, preferably of at least about 5.0, more preferably of at least about 5.5, and a preferred range of about 5.0-7.0, through at least one spinnerette to form molten polypropylene filaments; and quenching the molten polypropylene filaments under conditions to obtain filaments having an average rheological polydispersity index substantially corresponding to the rheological polydispersity index of the polypropylene containing composition.

Also according to the invention, a process is provided for producing a thermobondable fiber having an average rheological polydispersity index of at least about 4.5, preferably of at least about 5.0, more preferably of at least about 5.5, and a preferred range of about 5.0-7.0, which is substantially maintained throughout the process, comprising melt spinning a polypropylene containing composition having a broad molecular weight distribution through at least one spinnerette to form molten polypropylene containing filaments; and quenching the molten polypropylene containing filaments under conditions to maintain a substantially uniform morphology of the quenched polypropylene containing filaments having an average rheological polydispersity index substantially corresponding to the rheological polydispersity index of the polypropylene containing composition.

Also according to the invention, a process is provided for spinning polypropylene containing filaments comprising melt spinning a polypropylene containing composition having

a broad molecular weight distribution through at least one spinnerette at a spinning speed of about 30 to 200 meters per minute, preferably 80 to 100 meters per minute, to form molten polypropylene containing filaments; and quenching the molten polypropylene containing filaments to obtain polypropylene containing filaments having an average rheological polydispersity index of at least about 4.5, preferably of at least about 5.0, more preferably of at least about 5.5. Preferably, the filaments have an elongation greater than about 250%. Further, the polypropylene containing composition preferably contains at least about 3.0%, preferably at least about 10.0%, of at least one polypropylene having a melt flow rate of about 60-1000, preferably of about 200-1000. Preferably, the filaments have an average melt flow rate of about 5-40, more preferably an average melt flow rate of about 10-30, and most preferably an average melt flow rate of about 15-25.

Also according to the invention, a process is provided for spinning polypropylene containing filaments comprising melt spinning a polypropylene containing composition having a broad molecular weight distribution, and containing at least about 3.0%, preferably at least about 10.0%, of at least one polypropylene having a melt flow rate of about 60-1000, preferably a melt flow rate of about 200-1000, through at least one spinnerette at a spinning speed of about 30 to 200 meters per minute, preferably of about 80-100 meters per minute, to form molten polypropylene containing filaments; and quenching the molten polypropylene containing filaments to obtain polypropylene containing filaments having an average melt flow rate of about 5-40. Preferably, the filaments have an average rheological polydispersity index of at least about 4.5, more preferably of at least about 5.0, even more preferably of at least about 5.5, and an elongation greater than about 250%.

All of the processes of the invention can use the spinning speeds, drawing and crimping, and quenching steps as described throughout the disclosure.

According to the invention, there is provided a non-woven material comprising fibers as described above that are

thermally bonded together, products having at least one layer of a non-woven material according to the present invention; and hygienic product, including diapers, incontinence products and sanitary napkins, comprising at least one liquid impermeable layer, and least one absorbent layer, and at least one non-oven fabric comprising fibers as above-described thermally bonded together. For example, the diaper according to the invention can include an outer impermeable layer, an inner non-woven fabric layer comprising fibers according to the invention, and an intermediate absorbent layer.

Also according to the invention, a non-woven material is provided comprising polypropylene containing fibers having an average melt flow rate of about 5-40, preferably about 10-30, more preferably about 15-25, and containing at least about 3.0%, preferably at least about 10.0%, of at least one polypropylene having a melt flow rate of about 60-1000, preferably a melt flow rate of about 200-1000 thermally bonded together.

Also according to the invention, a non-woven material is provided comprising polypropylene containing fibers having an average rheological polydispersity index of at least about 4.5, preferably about 5.0, more preferably about 5.5, and a preferred range of about 5.0-7.0, and containing at least about 3.0%, preferably at least about 10.0%, of at least one polypropylene having a melt flow rate of about 60-1000, preferably having a melt flow rate of about 200-1000, thermally bonded together. Preferably, the polypropylene containing fiber has an average melt flow rate of about 5-40, more preferably about 10-30, and most preferably about 15-25.

5 In one broad aspect, therefore, the present invention relates to a polypropylene composition comprising at least one polypropylene having a melt flow rate of about 0.5-30, and at least one polypropylene having a melt flow rate of about 60-1000.

10 In another broad aspect, the present invention relates to a fibre comprising at least one polypropylene having a melt flow rate of about 0.5-30, and at least one polypropylene having a melt flow rate of about 60-1000.

15 In still another broad aspect, the present invention relates to a polypropylene fibre comprising a mixture of at least two components, said at least two components comprising at least one first component of polypropylene having a melt flow rate of about 0.5-30, and at least one second component of polypropylene having a melt flow rate of about 60-1000, and the fibre having an average melt flow rate of about 5-40.

20 In a further broad aspect, the present invention relates to a polypropylene fibre, said fibre having an average melt flow rate of about 5-40, comprising at least about 3.0% of at least one polypropylene having a melt flow rate of about 200-1000.

25 In yet another broad aspect, the present invention relates to a polypropylene fibre, said fibre having an average rheological polydispersity index of at least about 4.5, said fibre including in its composition at least about 3.0% of at least one polypropylene having a melt flow rate of about 200-1000.

30 In a further broad aspect, the present invention relates to a polypropylene fibre, said fibre having a zero shear viscosity of at least about 2.0×10^4 poise, and a viscoelastic constant of at least about 1.50.

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In another broad aspect, the present invention relates to a process for spinning polypropylene filaments comprising: melt spinning a polypropylene composition
5 having a broad molecular weight distribution through at least one spinnerette to form molten polypropylene filaments, the polypropylene composition comprises at least one polypropylene having a melt flow rate of about 0.5-30, and at least one polypropylene having a melt flow
10 rate of about 60-1000; and quenching the molten polypropylene filaments to obtain polypropylene filaments having an average rheological polydispersity index of at least about 5.0.

In yet another broad aspect, the present invention
15 relates to a process for spinning polypropylene filaments comprising: melt spinning a polypropylene composition having a broad molecular weight distribution through at least one spinnerette at a spinning speed of about 30 to 200 meters per minute to form molten polypropylene
20 filaments; and quenching the molten polypropylene filaments.

In another broad aspect, the present invention relates to a process for producing thermobondable polypropylene filaments having an average rheological
25 polydispersity index of at least about 4.5 which is substantially maintained throughout the process, comprising: melt spinning a polypropylene composition having a broad molecular weight distribution with an average rheological polydispersity index of at least
30 about 4.5 through at least one spinnerette to form molten polypropylene filaments said polypropylene composition including at least one polypropylene having a melt flow rate of about 0.5 - 30 and at least one polypropylene

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having a melt flow rate of about 60 - 1000; and quenching the molten polypropylene filaments under conditions to obtain polypropylene filaments having an average
5 rheological polydispersity index of at least about 4.5, preferably, the spinning speed is about 30 to 200 meters per second.

In another broad aspect, the present invention relates to a process for producing thermobondable
10 polypropylene filaments having substantially uniform morphology, and an average rheological polydispersity index of at least about 4.5 which is substantially maintained throughout the process, comprising: melt spinning a polypropylene composition having a broad
15 molecular weight distribution through at least one spinnerette to form molten polypropylene filaments; and quenching the molten polypropylene filaments under conditions to maintain a substantially uniform morphology of the quenched polypropylene filaments having an average
20 rheological polydispersity index of at least about 4.5.

In still another broad aspect, the present invention relates to a process for spinning polypropylene filaments comprising: melt spinning a polypropylene composition having a broad molecular weight distribution, and
25 containing at least about 3.0% of at least one polypropylene having a melt flow rate of about 60-1000, through at least one spinnerette at a spinning speed of about 30 to 200 meters per minute to form molten polypropylene filaments; and quenching the molten
30 polypropylene filaments to obtain polypropylene filaments having an average melt flow rate of about 5-40.

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In another broad aspect, the present invention relates to a non-woven material comprising polypropylene fibres having an average melt flow rate of about 5-40 and including in their composition at least about 3.0% of at least one polypropylene having a melt flow rate of about 60-1000 thermally bonded together.

In a further broad aspect, the present invention relates to a non-woven material comprising polypropylene fibres having an average rheological polydispersity index of at least about 4.5, and including in their composition at least about 3.0% of at least one polypropylene having a melt flow rate of about 60-1000, thermally bonded together.

The present invention also relates to personal hygiene articles comprising at least one impermeable layer, at least one absorbant layer, and at least one layer of non-woven material comprising a non-woven material comprising polypropylene fibres having an average melt flow rate of about 5-40 and including in their composition at least about 3.0% of at least one polypropylene having a melt flow rate of about 60-1000 thermally bonded together or a non-woven material comprising polypropylene fibres having an average rheological polydispersity index of at least about 4.5, and including in their composition at least about 3.0% of at least one polypropylene having a melt flow rate of about 60-1000, thermally bonded together.

The present invention also relates to a personal hygiene article comprising at least one liquid impermeable layer at least one absorbant layer and at least one layer of non-woven material produced by a fibre

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comprising at least one polypropylene having a melt flow rate of about 0.5-30, and at least one polypropylene having a melt flow rate of about 60-1000.

5 The fibre may comprise at least about 10.0% by weight of said at least one polypropylene having a melt flow rate of about 0.5-30, and at least about 10.0% by weight of said at least one polypropylene having a melt flow rate of about 60-1000. Moreover, preferably said at
10 least one polypropylene having a melt flow rate of 0.5-30 comprises at least one polypropylene having a melt flow rate of about 1-25, and said at least one polypropylene having a melt flow rate of about 60-1000 comprises at least one polypropylene having a melt flow rate of about
15 200-1000.

 The fibre may comprise about 2-5% by weight of polypropylene having a melt flow rate of about 0.5-5, about 70-85% by weight of polypropylene having a melt flow rate of about 10-20, and about 10-28% by weight of
20 polypropylene having a melt flow rate of about 300-600.

 The fibre may have an average rheological polydispersity index of at least about 4.5.

 In a further broad aspect, the present invention relates to a polypropylene fibre comprising a mixture of
25 at least two components, said at least two components comprising at least one first component of polypropylene having a melt flow rate of about 0.5-30, and at least one second component of polypropylene having a melt flow rate of about 60-1000, and the fibre having an average melt
30 flow rate of about 5-40.

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5 In a further broad aspect, the present invention relates to a polypropylene fibre, said fibre having an average melt flow rate of about 5-40, comprising at least about 3.0% of at least one polypropylene having a melt flow rate of about 200-1000.

10 In yet another broad aspect, the present invention relates to a polypropylene fibre, said fibre having an average rheological polydispersity index of at least about 4.5, said fibre including in its composition at least about 3.0% of at least one polypropylene having a melt flow rate of about 200-1000. Said fibre preferably has an average melt flow rate of about 5-40.

15 In a further broad aspect, the present invention relates to a polypropylene fibre, said fibre having a zero shear viscosity of at least about 2.0×10^4 poise, and a viscoelastic constant of at least about 1.50.

Said fibre has preferably an average rheological polydispersity index of at least about 5.0.

20 Moreover, the fibre of the present invention may have a substantially uniform morphology, and said fibre is substantially uniformly stainable with ruthenium tetroxide.

25 The present invention also relates to a personal hygiene article comprising a thermally bonded non-woven material comprising a fibre produced by spinning polypropylene filaments as follows: melt spinning a polypropylene composition having a broad molecular weight distribution through at least one spinnerette to form
30 molten polypropylene filaments, the polypropylene composition comprises at least one polypropylene having a melt flow rate of about 0.5-30, and at least one

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polypropylene having a melt flow rate of about 60-1000;
and quenching the molten polypropylene filaments to
obtain polypropylene filaments having an average
5 rheological polydispersity index of at least about 5.0.
The spinning speed may be about 30 to 200 meters per
minute.

In a further broad aspect, the present invention
relates to a process for producing thermobondable
10 polypropylene filaments having an average rheological
polydispersity index of at least about 4.5 which is
substantially maintained throughout the process,
comprising: melt spinning a polypropylene composition
having a broad molecular weight distribution with an
15 average rheological polydispersity index of at least
about 4.5 through at least one spinnerette to form molten
polypropylene filaments said polypropylene composition
including at least one polypropylene having a melt flow
rate of about 0.5 - 30 and at least one polypropylene
20 having a melt flow rate of about 60 - 1000; and quenching
the molten polypropylene filaments under conditions to
obtain polypropylene filaments having an average
rheological polydispersity index of at least about 4.5.

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In this process, the spinning speed is preferably about 30 to 200 meters per minute.

5 In another broad aspect, the present invention relates to a process for producing thermobondable polypropylene filaments having substantially uniform morphology, and an average rheological polydispersity index of at least about 4.5 which is substantially maintained throughout the process, comprising: melt
10 spinning a polypropylene composition having a broad molecular weight distribution through at least one spinnerette to form molten polypropylene filaments, said polypropylene composition including at least one polypropylene having a melt flow rate of about 0.5 - 30
15 and at least one polypropylene having a melt flow rate of about 60 - 1000; and quenching the molten polypropylene filaments under conditions to maintain a substantially uniform morphology of the quenched polypropylene filaments having an average rheological polydispersity
20 index of at least about 4.5. Preferably, the spinning speed is about 30 to 200 meters per minute.

The filaments, in the process of the present invention may have an elongation greater than about 250%. Moreover, the average rheological polydispersity index of
25 the quenched polypropylene filaments is preferably at least about 4.5. Further, based on the weight of the composition, said composition comprises at least about 3.0% by weight of said at least one polypropylene having a melt flow rate of about 0.5-30, and at least about 3.0%
30 by weight of said at least one polypropylene having a melt flow rate of about 60-1000. The polypropylene

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composition may contain at least about 3.0% of at least one polypropylene having a melt flow rate of about 60-1000.

5 In another broad aspect, the present invention relates to a process for spinning polypropylene filaments comprising: melt spinning a polypropylene composition having a broad molecular weight distribution, and
10 polypropylene having a melt flow rate of about 60-1000, through at least one spinnerette at a spinning speed of about 30 to 200 meters per minute to form molten polypropylene filaments; and quenching the molten polypropylene filaments to obtain polypropylene filaments
15 having an average melt flow rate of about 5-40.

 Because the fiber of the present invention provides superior bond strength compared with conventional polypropylene fiber, the non-woven material thus produced exhibits superior cross-directional tensile properties.
20 Further, non-woven material produced with the fiber of the present invention has superior elongation, uniformity, loftiness, white coloration and softness, while exhibiting the above-noted superior mechanical properties.

As used herein, polypropylene is utilized in its ordinary commercial meaning wherein the polypropylene is a substantially linear molecule. Further, as used herein, a polypropylene composition includes a material which contains a broad molecular weight distribution of linear polypropylene to enable the obtaining of fibers and filaments which have superior spinning and thermal bonding characteristics. Moreover, the fibers and filaments of the present invention provide non-woven materials of exceptional cross-directional strength, elongation, uniformity, loftiness and softness, by utilizing the disclosed polypropylene compositions including the disclosed linear polypropylene components having a broad molecular weight distribution, whether or not other components are present therein. Further, as used herein, polypropylene includes homopolymers of propylene, various polymers containing propylene, such as copolymers and terpolymers of propylene, and polypropylene mixtures (including blends and alloys produced by mixing separate batches or forming a blend in situ) with other substances and polymers. For example, the polymer can comprise copolymers of propylene, and these copolymers can contain various components. Preferably, such copolymers include up to about 10 weight % of at least one of ethylene and butene, but can contain varying amounts thereof depending upon the desired fiber or filament.

By practicing the process of the present invention, utilizing spin compositions according to the present invention, fibers and filaments can be obtained which have superior spinning and thermal bonding characteristics. Moreover, the fibers and filaments of the present invention provide non-woven materials of exceptional cross-directional strength, elongation, uniformity, loftiness and softness, by utilizing a material which contains a broad molecular weight distribution of linear polypropylene, whether or not other components are present therein.

The present invention is directed to various forms of fibers, including filaments and staple fibers. These terms are used in their ordinary commercial meanings. Typically, herein, filaments is used to refer to the continuous fiber on the spinning machine. "Staple fiber" is used to refer to cut fibers or filaments. Preferably, for instance, staple fibers for nonwoven fabrics useful in diapers have lengths of about 1 to 3 inches, more preferably 1.25 to 2 inches.

The polypropylene from which the improved fiber of the present invention can be produced includes at least one polypropylene having a melt flow rate of about 0.5-30, preferably about 1-25, and at least one polypropylene having a melt flow rate of about 60-1000, preferably about 200-1000. Preferably, based on the weight of the composition, the at least one polypropylene having a melt flow rate of about 0.5-30 is present in an amount of about 5-95%, and the at least one polypropylene having a melt flow rate of about 60-1000 is present in an amount of about 5-95%.

Preferably, based on the weight of the composition, the composition comprises at least about 3.0% by weight of the at least one polypropylene having a melt flow rate of about 0.5-30, and at least about 3.0% by weight of the at least one polypropylene having a melt flow rate of about 60-1000. More preferably, based on the weight of the composition, the composition comprises at least about 10.0% by weight of the at least one polypropylene having a melt flow rate of about 0.5-30, and at least about 10.0% by weight of the at least one polypropylene having a melt flow rate of about 60-1000.

More preferably, the composition comprises about 2-5 % by weight, preferably, about 3% by weight of polypropylene having a melt flow rate of about 0.5-5, preferably about 0.8-5.0, and more preferably about 1.0-3.0, about 70-85% by weight, preferably about 75% by weight, of polypropylene having a melt flow rate of about 10-20, preferably about 10-15, and about 10-28% by weight, preferably about 22% by weight of polypropylene having a melt flow rate of about 300-600, preferably about 350-450.

In a particular embodiment of the invention, the polypropylene fiber can be made by blending at least one polypropylene having a melt flow rate of about 0.5-30, preferably about 1-25, and at least one polypropylene having a melt flow rate of about 60-1000, preferably about 200-1000 to form a composition, and then melt spinning the composition according to known procedures. The melt flow rate (MFR) as described herein is determined according to ASTM D-1238 (condition L;230/2.16).

The polypropylene to be made into fibers can comprise

mixtures of more than one polypropylene within each defined MFR range. The melt flow rate of the mixture used to make the fiber of the present invention, as well as the fiber
5 itself, has an average melt flow rate of about 5-40, preferably about 10-30, and more preferably about 15-25.

While the polypropylenes can be blended to obtain a broad mixture of molecular weights in the polypropylene to be produced into fibers, as an alternative to blending
10 separate polymers to obtain the unique composition of the present invention, the components of the propylene to be produced into fibers can be made in situ by polymerizing propylene with or without ethylene or butane by known multi-reactor procedures, such as disclosed in Seiler and
15 Goller, "Propylene (PP)," KUNSTSTOFFE 80 (1990) 10, pages 1085-1092.

Known processes for making staple fiber include a conventional "two-step long spin" process or "one-step short spin" process. The long spin process involves first
20 melt-extruding fibers at typical spinning speeds of 500 to 1500 meters per minute. Typically, in a second step run at 100 to 250 meters per minute, these fibers are then drawn, crimped, and cut into staple fiber. The one-step short spin process involves conversion from polymer to staple
25 fibers in a single step where typical spinning speeds are in the range of 50 to 200 meters per minute. The productivity of the one-step process is increased with the use of about 5 to 20 times the number of holes in the spinnerette compared to that typically used in the long
30 spin process. For example, spinnerettes for a typical "long spin" process would include approximately 50-4000, preferably approximately 3000-3500 holes, and spinnerettes for a typical "short spin" process would include approximately 4000 to 100,000 holes preferably, about

30,000-70,000. Typical temperatures for extrusion of the spin melt are about 250-300°C.

5 Other means of production of fibrous products include well known melt spun and melt blown processes, which provide continuous filaments-based non-woven fabrics and micro-denier staple-based non-woven fabrics, respectively. The fiber according to the present invention includes the long filamentous fibers made according to well known spun
10 bond processes, as well as staple fibers made by the aforementioned short spin and long spin processes.

The fiber of the present invention has a preferable denier per filament (dpf) of no greater than about 5.0, preferably between about 0.5 and 3.0.

15 In making the fiber in accordance with the present invention, at least one stabilizer (including antioxidants) is preferably mixed with the polypropylene to be made into a fiber in an amount ranging from about 0.02-1.0 fiber-weight %, preferably about 0.05-0.2 fiber-weight %, in
20 order to prevent deterioration of the fiber after production. Such stabilizers are well known in polypropylene-fiber manufacture and include phenylphosphites (available from General Electric Co. under the name ULTRANOX*626, and from Sandoz Chemical Co. under the name
25 SANDOSTAB* PEP-Q), N,N'-bis-piperidinyl diamine-containing materials (available from Ciba Geigy Corp. under the names CHIMASSORB* 119 and CHIMASSORB 944), and hindered phenolics (available under the names CYANOX* 1790 from American Cyanamid Co. and IRGANOX* 1076 from Ciba Geigy Corp.) The
30 at least one stabilizer can be mixed into the blend of polypropylenes, or can be separately added to polypropylenes that are to be mixed together to form a blend to be produced into fibers.

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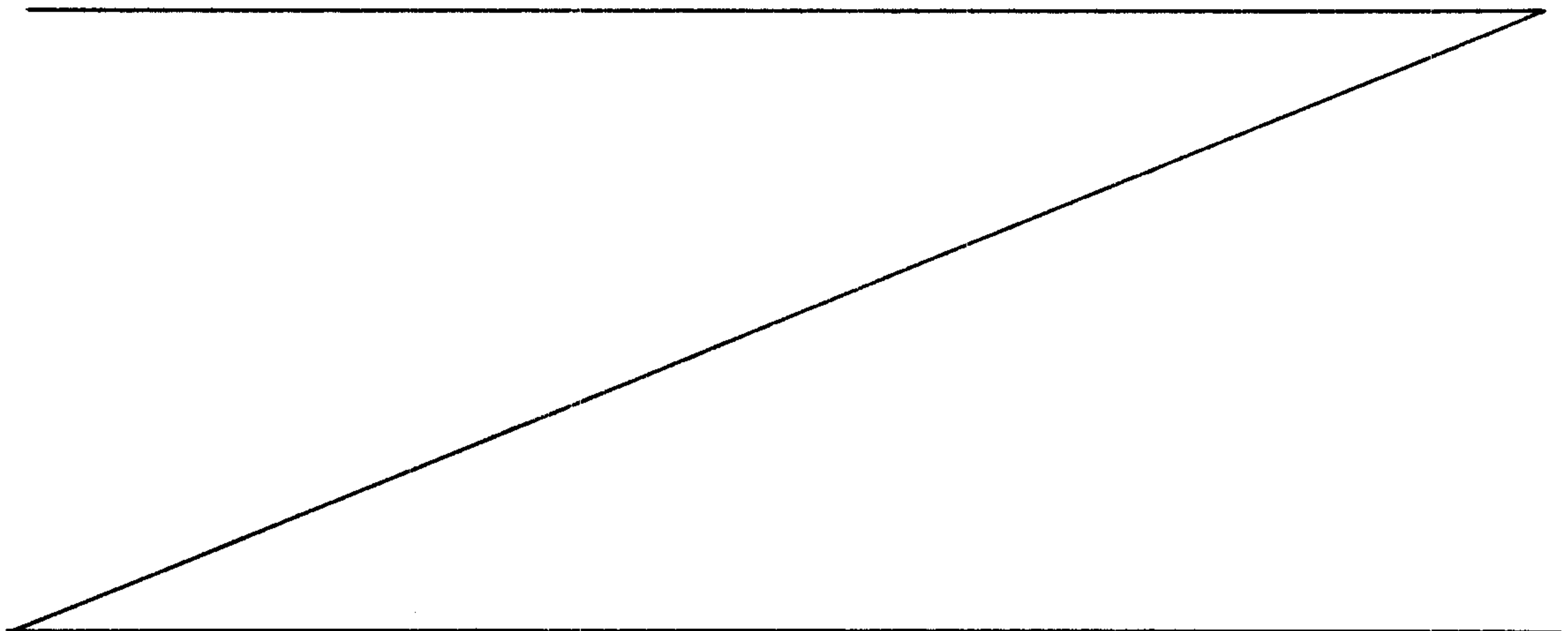
Optionally, whiteners such as titanium dioxide, in amounts up to about 2 fiber-weight %, antacids such as calcium stearate, in amounts ranging from about 0.05-0.2 fiber-weight %, colorants, in amounts ranging from 0.01-2.0 and other well known additives are included in the fiber of the present invention. Wetting agents, such as disclosed in U.S. Patent No. 4,578,414 are also usefully incorporated into the fiber of the present invention. Other commercially available useful additives include IRGAFOS* 168 (available from American Cyanamid Co.), and LUPERSOL* 101 (available from Pennwalt Corp.).

In making the fiber of the present invention, the polypropylene to be made into a fiber preferably includes about 5-95 fiber-weight % of polypropylene having a melt flow rate of about 0.5-30, and about 5-95 fiber weight % polypropylene having a melt flow rate of about 60-1000. Preferably, based on the weight of the composition, the at least one polypropylene having a melt flow rate of about 0.5-30 is present in an amount of about 5-95, and the at least one polypropylen having a melt flow rate of about 60-1000 is present in an amount of about 5-95%. More preferably, the composition comprises about 2-5% by weight, preferably, about 3% by weight, of polypropylene having a melt flow rate of about 0.5-5, preferably about 0.8-5.0, more preferably about 1.0-3.0, about 70-85% by weight, preferably 75% by weight, of polypropylene having a melt flow rate of about 10-20, preferably about 10-15, and about 10-28% by weight, preferably about 22% by weight of polypropylene having a melt flow rate of about 300-600, preferably about 400.

Preferably, the fiber made in accordance with the present invention has an average rheological polydispersity

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index (PI) of at least about 4.5, preferably at least about 5.0, and more preferably between about 5.0 and 7.0 as measured according to Zeichner and Patel, Proceedings of
5 Second World Congress of Chemical Engineering, Montreal,
Vol. 6, pp. 333-337 (1981). In accordance with this reference, the dynamic shear property of a small polymeric sample subjected to a small amplitude oscillatory motion. The sample is held between two parallel plates of 25
10 millimeters in diameter at a gap of two millimeters. The top plate is attached to a dynamic motor while the bottom plate is attached to a 2000 gm-cm torque transducer of a Rheometrics^(R) Dynamic Spectrometer or Analyzer. The test temperature is held at 200°C. While keeping the bottom
15 plate stationary, a small amplitude oscillatory motion is imposed on the top plate sweeping the frequency range from 0.1 to 500 radian/second. At each frequency, after the transients have died out, the dynamic stress response is separable into in-phase and out-of-phase components of the
20 shearing strain. The dynamic modulus, G' , characterizes the in-phase component while the loss modulus, G'' , characterizes the out-of-phase component of the dynamic stress. For high molecular weight polyolefins, such as polypropylenes, it is observed that these moduli crossover
25 at a point when measured as a function of frequency. This



crossover modulus is characterized as G_c , and the crossover frequency is characterized by W_c .

The polydispersity index is defined by $10^6/\text{crossover modulus}$, and is found to correlate with the molecular weight distribution, M_w/M_n . The crossover frequency correlates inversely with the weight average molecular weight, M_w , for polypropylenes.

Preferably, the fiber of the present invention also has a viscoelastic constant of about 1.5-2.0. The viscoelastic constant (VC) is defined according to the equation $VC = \eta_0 / (G_c / W_c)^{1.21}$, where " η_0 " is the zero shear viscosity in poise, and " G_c / W_c " is the ratio of crossover modulus to crossover frequency in poise, that is (dyne)(sec)/cm². The values of G_c and W_c are determined utilizing the dynamic shear procedure described above. However, the zero shear viscosity is determined utilizing a low shear steady shear procedure in which a cone and plate fixture are used as the platens instead of the two parallel plates in the dynamic shear procedure. More specifically, the cone has a cone angle of 0.1 radian, and both the cone and the plate are 25 mm in diameter. The test temperature is held at 200°C, as with the dynamic shear procedure. While maintaining the bottom plate stationary, a constant rotational motion is imposed on the top cone at a constant shear rate. After an elapsed time, the stress measured by the transducer maintains a constant value. The viscosity is computed from this steady stress, and the imposed shear rate. The zero shear viscosity, η_0 , is defined as the viscosity of a high molecular weight polymer in which the viscosity is invariant as a function of shear rate. The zero shear viscosity is measured by performing the shear sweep from a shear rate of 0.001 sec⁻¹ to 3.0 sec⁻¹. The zero shear viscosity is obtained in the low shear rate region, and it is the viscosity that has an associated torque greater than 2 gm-cm, and does not vary with shear rate.

The filaments and fibers of the present invention have a substantially uniform structure. This structure is different from the sheath-core differential morphology that is associated with the polypropylene filaments and fibers disclosed in EP-A-445,536 to Kozulla, and corresponding

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subject matter of which was laid open on August 6, 1991 in Canadian Laid-Open Patent Application No. 2,035,575.

5 The substantially uniform morphological structure of the filaments and fibers according to the present invention is characterizable by transmission electron microscopy (TEM) of ruthenium tetroxide (RuO_4)-stained fiber thin sections. In this regard, as taught by Trent et al., in Macromolecules, vol. 16, No. 4, 1983, "Ruthenium Tetroxide staining of Polymers for Electron Microscopy", it is well known that the microphology of
10 polymeric materials is dependent on their heat treatment, composition, and processing, and that, in turn, mechanical properties of these materials such as toughness, impact, strength, resilience, fatigue, and fracture strength can be highly sensitive to morphology. Further, this article teaches
15 that transmission electron microscopy is an established technique for the characterization of the structure of heterogeneous polymer systems at a high level of resolution; however, it is often necessary to enhance image contrast for polymers by use of a staining agent. Useful staining agents for polymers are taught
20 to include osmium tetroxide and ruthenium tetroxide. For the staining of the filaments and fibers of the present invention, ruthenium tetroxide is the preferred staining agent.

In the morphological characterization of the present invention, samples of filaments or fibers are stained with
25 aqueous RuO_4 , such as a 0.5% (by weight) aqueous solution of ruthenium tetroxide obtainable from Polysciences, Inc., overnight at room temperature. (While a liquid stain is utilized in this procedure, staining of the samples with a gaseous stain is also possible.) Stained fibers are embedded in Spurr* epoxy resin and
30 cured overnight at 60°C. The embedded stained fibers are then thin sectioned on an ultramicrotome using a diamond knife at room temperature to obtain microtome sections approximately 80 nm thick, which can be examined on conventional apparatus, such as a Zeiss* EM-10 TEM, at 100kV. Energy dispersive x-ray analysis
35 (EDX) was utilized to confirm that the RuO_4 had penetrated completely to the center of the fiber.

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Fibers that are produced according to sheath-core differential morphology of the above-referenced Kozulla applications show an enrichment of the ruthenium on the outside surface of the fiber (Ru residue), and on the outer sheath (approximately 1 μ m) of the fiber cross-section. Further, the core of these Kozulla fibers show a much lower ruthenium content. In contrast, fibers that are produced according to the present invention have a more uniform distribution of ruthenium across the fiber cross-section than the fiber produced according to the sheath-core differential morphology of Kozulla, and do not illustrate a sheath-core differential morphology.

It is also preferred that the fiber of the present invention have a tenacity no greater than about 2.5 g/denier, and a fiber elongation of at least about 250%, as measured on individual fibers using a FAFEGRAPH* tensile tester with a fiber gauge length of about 1.25 cm and an extension rate of about 200%/min (average of 10 fibers tested). Fiber tenacity is defined as the breaking force divided by the denier of the fiber, while fiber elongation is defined as the % elongation to break.

As discussed above, the present invention provides non-woven materials including the fibers according to the present invention thermally bonded together. By incorporating the fibers of the present invention into non-woven materials, non-woven materials of exceptional cross-directional strength and percent elongation can be obtained. These non-woven materials can be used as at least one layer in various products, including hygienic products, such as diapers, incontinence products and diapers, comprising at least one liquid absorbent layer, at least one liquid impermeable layer and at least one non-woven material layer incorporating fibers of the present invention thermally bonded together. For example, a diaper incorporating a non-woven fabric of the present invention would include, as a preferred embodiment, an outermost layer, an inner layer of the non-woven material, and at least one intermediate absorbent layer. Of course, a plurality of non-woven material layers and absorbent layers can be incorporated in the diaper (or other hygienic product) in various

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orientations, and a plurality of outer impermeable layers can be included for strength considerations.

In order to more clearly describe the present invention, the following non-limiting examples are provided. All parts and percentages in the examples are by weight unless indicated otherwise.

EXAMPLE 1

Fibers (2.2 dpf) are prepared using the one-step short spin process with an inside-out radial quench system. The spinnerette contains 64,030 holes, each having a diameter of 0.35 mm. Quench air velocity of about 16-30 meters/second and a spinning speed of 75 meters/minute are used. Fibers are crimped at about 8-12 crimps/cm, coated with a 0.4-0.8 fiber-weight% finish mixture of an ethoxylated fatty acid ester and an ethoxylated alcohol phosphate (available from George A. Goulston Co., Inc., Monroe, NC, under the name LUROL* PP 912), and cut into 3.8 cm long staple.

The following polymers are used. Polymer I is a homopolymer of propylene having a MFR of 20 and a PI of 4.2. Polymer II is a homopolymer of propylene having a MFR of 10 and a PI of 5.0. Polymer III is a homopolymer of propylene having a MFR of 18 and a PI of 4.6 (PV711* from Himont Canada). Polymer IV is a homopolymer of propylene having a MFR of 400 $\pm$ 40 and a PI of 3.5 $\pm$ 0.3 (VALTEC* HH441 Himont Inc., Wilmington Delaware). Fiber samples A-H are prepared using the formulations and conditions as set forth in the following Table 1. Fiber samples B-F are examples of the present invention, and fiber samples A, G, and H are controls. Additives % are based on fiber weight.

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TABLE 1

Fiber Formulation		Spin Temp. °C ¹	Draw Temp. °C ²
5	A polymer I 0.1% IRGAFOS*168 0.1% calcium stearate 0.02% IRGANOX*1076	270	49/35
	B 80% polymer II 20% polymer IV 0.06% ULTRANOX*626 0.05% calcium stearate 0.01% IRGANOX 1076	270	49/32
	C 80% polymer II 20% polymer IV 0.06% ULTRANOX*626 0.05% calcium stearate 0.01% IRGANOX 1076	280	51/31
	D 90% polymer III 10% polymer IV 0.06% ULTRANOX*626 0.05% calcium stearate 0.01% IRGANOX 1076	260	51/36
	E 85% polymer III 15% polymer IV 0.06% ULTRANOX*626 0.05% calcium stearate 0.01% IRGANOX 1076	260	50/36
35	F 80% polymer II 20% polymer IV 0.1% IRGAFOS*168 0.05% calcium stearate 0.01% IRGANOX 1076	280	51/33
	G polymer II 0.1% EBS ³ 0.01% LUPERSOL*101 0.1% IRGAFOS 168 0.05% calcium stearate 0.01% IRGANOX 1076	280	49/35
45	H polymer II 0.1% EBS 0.01% LUPERSOL*101 0.1% IRGAFOS 168 0.05% calcium stearate 0.01% IRGANOX 1076	280	49/35

¹Extruder zones temperature.²Feed-roll temperature/draw-roll temperature.³bis-(p-ethylbenzylidene)sorbitol (obtainable from Mitsui Toatsu Chemicals, Japan).

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The fiber samples are tested to determine MFR, PI, and elongation as described hereinabove. Fibers from each sample are then made into a non-woven material (average weight 23.8 g/m²) by thermally bonding a web of the fibers at 75 m/min card bond line speed at a temperature of 150-180°C using a calendar roll having diamond bond points with a total bond area of about 20%. Cross-directional (CD) strength of the resulting fabric is determined by testing samples 2.5 cm wide and 12.5 cm long that have been cut in the cross direction of the fabric production. CD strength is expressed in grams of force needed to break the fabric at the extension rate of 12.5 cm/min. Fiber and fabric test results (CD strength being for the fabric) are reported in the following Table 2.

TABLE 2

Sample	MFR dg/min	P.I.	Draw Ratio	Elong	CD Strength g/in	Zero Shear Viscosity (10 ⁴ Poise)	VC
A	27	4.6	1.2X	378	565	1.07	1.56
B	18	5.6	1.2X	413	789	2.39	1.78
C	18	5.7	1.2X	396	683	2.36	1.76
D	25	4.8	1.33X	347	663		
E	26	4.8	1.33X	409	649		
F	20	5.3	1.1X	324	742		
G	23	3.8	1.1X	330	470		
H	23	4.1	1.3X	304	497		

Comparing results for samples B-F with controls A, G, and H demonstrates that the fibers of the present invention exhibit superior fabric strength and thermal bonding properties.

EXAMPLE 2

Fibers (2.2 dpf) are prepared using a one-step spinning process with a cross-blow quench system. Spinnerettes contained 30,500 0.3 mm diameter holes. Quench air velocity is about 30-35 meters per second. The spinning speed is 86 meters/minute and the drawing speed is 103 meters/minute. The fibers are crimped at about 8-12 crimps/cm and cut into 4.8 cm long staple during the same process. Polypropylene polymers III and IV of the Example I are used in these experiments. Fiber samples J and K are prepared using the formulations and conditions as set forth in the following Table 3. Fiber sample K is an example of the present

invention, and fiber sample J is a control. Additives % are based on fiber weight.

TABLE 3

	Fiber Formulation	Spin Temp. °C ¹	Draw Temp. °C ²
5	J polymer III 0.06% CYANOX 1790 0.05% calcium stearate 0.1% TiO ₂ 0.01% IRGANOX 1076	235	60/60
10	K 95% polymer III 5% polymer IV 0.085% ULTRANOX 626 0.07% calcium Stearate 0.14% TiO ₂ 0.01% IRGANOX 1076	247	60/60

The fiber samples are tested and fabrics made and tested as in Example 1. Results are reported in the following Table 4. Again the CD strength pertains to the fabric and the other results pertain to the fiber.

TABLE 4

	Sample	MFR dg/min	P.I.	Draw Ratio	%Elong	CD Stren- gth g/in	Zero Shear Visco- sity (10 ⁴ Poise)	VC
25	J	22	4.3	1.2X	344	600	1.35	1.58
30	K	21	4.7	1.2X	376	660	1.56	1.68

Sample K of the present invention, which includes a broad molecular weight distribution, exhibits superior properties with respect to control J. Therefore, in one aspect of the present invention, by having a broad molecular weight distribution in the polypropylene composition that is subjected to melt spinning, superior cross-directional properties are obtained.

EXAMPLE 3

Fibers (2.2 dpf) are prepared using a two-step manufacturing process. Fiber spinning is carried out at 777 meters/minute using spinnerettes with 782 0.35 mm diameter holes. Fibers are crimped at 8-12 crimps/cm and cut into 3.8

¹Extruder zones temperature.

²Feed-roll temperature/draw-roll temperature.

cm long staple at a drawing speed of 120 meters/minute. Polymers II and IV of Example 1 are used. Fiber samples L and M are prepared using the formulations and conditions as set forth in the following Table 5. Fiber sample M is an example of the present invention, and fiber sample L is a control. Additives % are based on fiber weight.

TABLE 5

	Fiber Formulation	Spin Temp. °C ¹	Draw Temp. °C ²
10	L polymer II 0.085% ULTRANOX 626 0.05% calcium stearate 0.1% TiO ₂ 0.008% LUPERSOL 101	285	60/60
15	M 80% polymer II 20% polymer IV 0.085% ULTRANOX 626 0.05% calcium Stearate 0.1% TiO ₂	305	60/60
20			

The fiber samples are tested and fabrics made and tested as in Example 1. Results are reported in the following Table 6. Again, the CD strength pertains to the fabric and the other results pertain to the fiber.

TABLE 6

	Sample	MFR	P.I.	Draw Ratio	% Elong	CD Strength
30	L	26	4.2	1.2X	372	410
35	M	20	5.4	1.2X	506	600

Sample M of the present invention exhibits superior properties with respect to control L.

Although the invention has been described with reference to particular means, materials and embodiments, it is to be understood that the invention is not limited to the particulars disclosed and extends to all equivalents within the scope of the claims.

¹Extruder zones temperature.

²Feed-roll temperature/draw-roll temperature.

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THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A polypropylene composition comprising at least one polypropylene having a melt flow rate of about 0.5-30, and at least one polypropylene having a melt flow rate of about 60-1000.
2. The composition according to claim 1, which, based on weight of the composition comprises at least about 3.0% by weight of said at least one polypropylene having a melt flow rate of about 0.5-30, and at least about 3.0% by weight of said at least one polypropylene having a melt flow rate of about 60-1000.
3. The composition according to claim 2, which, based on weight of the composition comprises at least about 10.0% by weight of said at least one polypropylene having a melt flow rate of about 0.5-30, and at least about 10.0% by weight of said at least one polypropylene having a melt flow rate of about 60-1000.
4. The composition according to claim 1, wherein said at least one polypropylene having a melt flow rate of 0.5-30 comprises at least one polypropylene having a melt flow rate of about 1-25, and said at least one polypropylene having a melt flow rate of about 60-1000 comprises at least one polypropylene having a melt flow rate of about 200-1000.
5. The composition according to claim 2, wherein said at least one polypropylene having a melt flow rate of 0.5-30 comprises at least one polypropylene having a melt flow rate of about 1-25, and said at least one polypropylene

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having a melt flow rate of about 60-1000 comprises at least one polypropylene having a melt flow rate of about 200-1000.

6. The composition according to claim 1, comprising about 2-5% by weight of polypropylene having a melt flow rate of about 0.5-5, about 70-85% by weight of polypropylene having a melt flow rate of about 10-20, and about 10-28% by weight of polypropylene having a melt flow rate of about 300-600.
7. The composition according to any one of claims 1 - 6, having an average rheological polydispersity index of at least about 4.5.
8. A fibre comprising at least one polypropylene having a melt flow rate of about 0.5-30, and at least one polypropylene having a melt flow rate of about 60-1000.
9. The fibre according to claim 8, which, based on weight of the fibre comprises at least about 3.0% by weight of said at least one polypropylene having a melt flow rate of about 0.5-30, and at least about 3.0% by weight of said at least one polypropylene having a melt flow rate of about 60-1000.
10. The fibre according to claim 9, which, based on weight of the fibre comprises at least about 10.0% by weight of said at least one polypropylene having a melt flow rate of about 0.5-30, and at least about 10.0% by weight of said at least one polypropylene having a melt flow rate of about 60-1000.

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11. The fibre according to claim 8, wherein said at least one polypropylene having a melt flow rate of 0.5-30 comprises at least one polypropylene having a melt flow rate of about 1-25, and said at least one polypropylene having a melt flow rate of about 60-1000 comprises at least one polypropylene having a melt flow rate of about 200-1000.
12. The fibre according to claim 9, wherein said at least one polypropylene having a melt flow rate of 0.5-30 comprises at least one polypropylene having a melt flow rate of about 1-25, and said at least one polypropylene having a melt flow rate of about 60-1000 comprises at least one polypropylene having a melt flow rate of about 200-1000.
13. The fibre according to claim 8, comprising about 2-5% by weight of polypropylene having a melt flow rate of about 0.5-5, about 70-85% by weight of polypropylene having a melt flow rate of about 10-20, and about 10-28% by weight of polypropylene having a melt flow rate of about 300-600.
14. The fibre according to any one of claims 8 - 13, having an average rheological polydispersity index of at least about 4.5.
15. A polypropylene fibre comprising a mixture of at least two components, said at least two components comprising at least one first component of polypropylene having a melt flow rate of about 0.5-30, and at least one second component of polypropylene having a melt flow rate of about 60-1000, and the fibre having an average melt flow rate of about 5-40.

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16. A polypropylene fibre, said fibre having an average melt flow rate of about 5-40, comprising at least about 3.0% of at least one polypropylene having a melt flow rate of about 200-1000.
17. A polypropylene fibre, said fibre having an average rheological polydispersity index of at least about 4.5, said fibre including in its composition at least about 3.0% of at least one polypropylene having a melt flow rate of about 200-1000.
18. The polypropylene fibre according to claim 17, wherein said fibre has an average melt flow rate of about 5-40.
19. A thermobondable polypropylene fibre, said fibre having a zero shear viscosity of at least about 2.0×10^4 poise, and a viscoelastic constant of at least about 1.50.
20. A polypropylene fibre as claimed in claim 17, said fibre having an average rheological polydispersity index of at least about 5.0.
21. A polypropylene fibre according to any one of claims 15-20, wherein said fibre has a substantially uniform morphology, and said fibre is substantially uniformly stainable with ruthenium tetroxide.
22. A process for spinning polypropylene filaments comprising:
melt spinning a polypropylene composition having a broad molecular weight distribution through at least one spinnerette to form molten polypropylene filaments, the polypropylene composition comprises at least one polypropylene having a melt

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flow rate of about 0.5-30, and at least one polypropylene having a melt flow rate of about 60-1000;and

quenching the molten polypropylene filaments to obtain polypropylene filaments having an average rheological polydispersity index of at least about 5.0.

23. The process according to claim 22, wherein the spinning speed is about 30 to 200 meters per minute.

24. A process for spinning polypropylene filaments comprising:

melt spinning a polypropylene composition having a broad molecular weight distribution through at least one spinnerette at a spinning speed of about 30 to 200 meters per minute to form molten polypropylene filaments said polypropylene composition including at least one polypropylene having a melt flow rate of about 0.5 - 30 and at least one polypropylene having a melt flow rate of about 60 - 1000; and

quenching the molten polypropylene filaments.

25. The process according to claim 24, wherein the quenched filaments have an average rheological polydispersity index of at least about 4.5.

26. A process for producing thermobondable polypropylene filaments having an average rheological polydispersity index of at least about 4.5 which is substantially maintained throughout the process, comprising:

melt spinning a polypropylene composition having a broad molecular weight distribution with an average rheological polydispersity index of at least about 4.5 through at least one spinnerette to form molten polypropylene filaments said polypropylene composition including at least one polypropylene

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having a melt flow rate of about 0.5 - 30 and at least one polypropylene having a melt flow rate of about 60 - 1000; and quenching the molten polypropylene filaments under conditions to obtain polypropylene filaments having an average rheological polydispersity index of at least about 4.5.

27. The process according to claim 26, wherein the spinning speed is about 30 to 200 meters per minute.

28. A process for producing thermobondable polypropylene filaments having substantially uniform morphology, and an average rheological polydispersity index of at least about 4.5 which is substantially maintained throughout the process, comprising:

melt spinning a polypropylene composition having a broad molecular weight distribution through at least one spinnerette to form molten polypropylene filaments, said polypropylene composition including at least one polypropylene having a melt flow rate of about 0.5 - 30 and at least one polypropylene having a melt flow rate of about 60 - 1000; and

quenching the molten polypropylene filaments under conditions to maintain a substantially uniform morphology of the quenched polypropylene filaments having an average rheological polydispersity index of at least about 4.5.

29. The process according to claim 28, wherein the spinning speed is about 30 to 200 meters per minute.

30. The process according to any one of claims 24 - 29, wherein said filaments have an elongation greater than about 250%.

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31. The process according to anyone of claims 24 - 29, wherein the polypropylene composition contains at least about 3.0% of at least one polypropylene having a melt flow rate of about 60-1000.
32. The process according to claim 30, wherein the polypropylene composition contains at least about 3.0% of at least one polypropylene having a melt flow rate of about 60-1000.
33. A process for spinning polypropylene filaments comprising:
melt spinning a polypropylene composition having a broad molecular weight distribution, and containing at least about 3.0% of at least one polypropylene having a melt flow rate of about 60-1000, through at least one spinnerette at a spinning speed of about 30 to 200 meters per minute to form molten polypropylene filaments; and
quenching the molten polypropylene filaments to obtain polypropylene filaments having an average melt flow rate of about 5-40.
34. The process according to claim 33, wherein the average rheological polydispersity index of the quenched polypropylene filaments is at least about 4.5.
35. The process according to any one of claims 22 - 34, wherein, based on the weight of the composition, said composition comprises at least about 3.0% by weight of said at least one polypropylene having a melt flow rate of about 0.5-30, and at least about 3.0% by weight of said at least one polypropylene having a melt flow rate of about 60-1000.

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36. A non-woven material comprising polypropylene fibres having an average melt flow rate of about 5-40 and including in their composition at least about 3.0% of at least one polypropylene having a melt flow rate of about 60-1000 thermally bonded together.
37. A non-woven material comprising polypropylene fibres having an average rheological polydispersity index of at least about 4.5, and including in their composition at least about 3.0% of at least one polypropylene having a melt flow rate of about 60-1000, thermally bonded together.
38. A non-woven material comprising fibres as claimed in any one of claims 8 - 21, thermally bonded together.
39. A thermally bondable filament produced by the process of any one of claims 26 - 29.
40. A filament produced by the process of claim 31.
41. A filament produced by the process of claim 32.
42. A filament produced by the process of claim 33.
43. A personal hygiene article comprising at least one liquid impermeable layer, at least one absorbent layer and at least one layer of non-woven material as claimed in claim 36 or 37.
44. A personal hygiene article comprising at least one liquid impermeable layer, at least one absorbent layer and at least one layer of non-woven material as claimed in claim 38.

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45. A personal hygiene article comprising a thermally bonded non-woven material comprising a filament as claimed in claim 39.
46. A personal hygiene article comprising a non-woven material comprising a filament as claimed in claim 40.
47. A personal hygiene article comprising a non-woven material comprising a filament as claimed in claim 41.
48. A personal hygiene article comprising a non-woven material comprising a filament as claimed in claim 42.
49. An article as claimed in claim 43, said article comprising a diaper having an outer impermeable layer, an inner non-woven material layer, and an intermediate absorbent layer.
50. An article as claimed in claim 44, said article comprising a diaper having an outer impermeable layer, an inner non-woven material layer, and an intermediate absorbent layer.
51. An article as claimed in claim 45, said article comprising a diaper having an outer impermeable layer, an inner non-woven material layer, and an intermediate absorbent layer.
52. An article as claimed in claim 46, said article comprising a diaper having an outer impermeable layer, an inner non-woven material layer, and an intermediate absorbent layer.

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53. An article as claimed in claim 47, said article comprising a diaper having an outer impermeable layer, an inner non-woven material layer, and an intermediate absorbent layer.
54. An article as claimed in claim 48, said article comprising a diaper having an outer impermeable layer, an inner non-woven material layer, and an intermediate absorbent layer.
55. A fibre according to claim 14, wherein said fibre has a substantially uniform morphology.
56. A process as claimed in any one of claims 22, 23, 25, 26, 27, 28, 29, 30, 34 or 35, further comprising crimping and cutting the filaments so as to form staple fibres.
57. A process as claimed in claim 24, further comprising crimping and cutting the filaments so as to form staple fibres.
58. A process as claimed in claim 31, further comprising crimping and cutting the filaments so as to form a staple fibre.
59. A process as claimed in claim 32, further comprising crimping and cutting the filaments so as to form a staple fibre.
60. A process as claimed in claim 33, further comprising crimping and cutting the filaments so as to form a staple fibre.

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61. A process as claimed in any one of claims 22, 23, 25, 26, 27, 28, 29, 30, 34, or 35 wherein said filaments have a substantially uniform morphology and are substantially uniformly stainable with ruthenium tetroxides.
62. A process as claimed in claim 24, wherein said filaments have a substantially uniform morphology and are substantially uniformly stainable with ruthenium tetroxide.
63. A process as claimed in claim 31, wherein said filaments have a substantially uniform morphology and are substantially uniformly stainable with ruthenium tetroxide.
64. A process as claimed in claim 32, wherein said filaments have a substantially uniform morphology and are substantially uniformly stainable with ruthenium tetroxide.
65. A process as claimed in claim 34, wherein said filaments have a substantially uniform morphology and are substantially uniformly stainable with ruthenium tetroxide.
66. A process as claimed in claim 56, wherein said filaments have a substantially uniform morphology and are substantially uniformly stainable with ruthenium tetroxide.

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67. A process as claimed in claim 57, wherein said filaments have a substantially uniform morphology and are substantially uniformly stainable with ruthenium tetroxide.
68. A process as claimed in claim 58, wherein said filaments have a substantially uniform morphology and are substantially uniformly stainable with ruthenium tetroxide.
69. A process as claimed in claim 59, wherein said filaments have a substantially uniform morphology and are substantially uniformly stainable with ruthenium tetroxide.
70. A process as claimed in claim 60, wherein said filaments have a substantially uniform morphology and are substantially uniformly stainable with ruthenium tetroxide.